



2021 Astrophysics Medium Explorer (MIDEX), and Mission of Opportunity (MO) Preproposal Conference

Science Evaluation Overview

Linda S. Sparke
Astrophysics Explorers Program Scientist
NASA Headquarters
September 14, 2021



Science Requirements

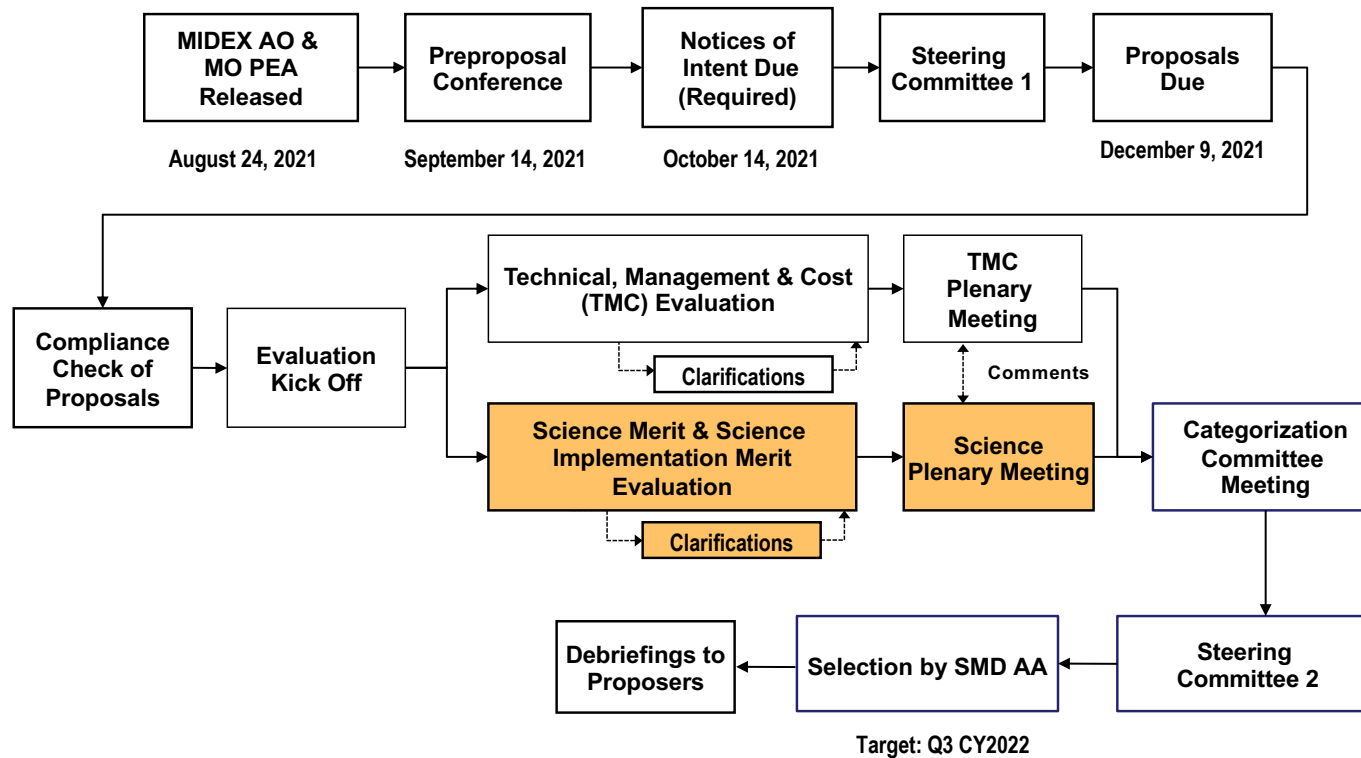
2021 Astrophysics Explorers
Preproposal Conference

-
- All investigations proposed in response to this solicitation must support the goals and objectives of the Astrophysics Explorers Program
 - One of NASA's strategic objectives is to discover how the Universe works, explore how it began and evolved, and search for life on planets around other stars.
 - The NASA Science Mission Directorate (SMD) addresses this strategic objective by conducting astrophysics investigations designed to:
 - Probe the origin and destiny of our Universe, including the nature of black holes, dark energy, dark matter and gravity;
 - Explore the origin and evolution of the galaxies, stars and planets that make up our universe;
 - Discover and study planets around other stars, and explore whether they could harbor life.
 - NASA's Strategic Plan, the NASA Science Plan, and the Astrophysics Roadmap *Enduring Quests Daring Visions*, *NASA Astrophysics in the Next Three Decades*, are available in the Program Library.



Proposal Evaluation Flow

2021 Astrophysics Explorers
Preproposal Conference





Scientific Merit and Science Implementation Merit

2021 Astrophysics Explorers
Preproposal Conference

- The information provided in a proposal will be used to assess the **intrinsic scientific merit** (Form A) and the **science implementation merit** (Form B) of the proposed investigation.
- Scientific merit will be evaluated for the **Baseline Science Mission** and the **Threshold Science Mission**.
- “**Baseline Science Mission**” is the mission that, if fully implemented, would fulfill the **Baseline Science Requirements**, which are the performance requirements necessary to achieve the full science objectives (MIDEX AO Section 5.1.4, and Req B-16)
- “**Threshold Science Mission**” is a descoped mission that would fulfill the Threshold Science Requirements, the performance requirements necessary to achieve the minimum acceptable data and scientific return for the mission, below which the mission would not be worth pursuing. (MIDEX AO Section 5.1.4, and Req B-18)

Requirement 9: Proposals shall specify only one Baseline Science Mission and only one Threshold Science Mission.

- Only the science panels consider the Threshold Mission; TMC evaluates only the Baseline Mission. See Q&A 1, 2 for both the MIDEX and the MO.



MIDEX (and MO) Requirements: science goals and objectives (MIDEX AO Section 5.1.1)

2021 Astrophysics Explorers
Preproposal Conference

Requirement 3: Proposals shall describe a **science investigation** with **goals** and **objectives** that address the program science objectives described in Section 2.

Requirement 4: Proposals shall demonstrate how the proposed investigation will fully achieve the proposed **objectives**.

A **goal** has a broad scope: e.g., understand dense matter inside neutron stars

An **objective** is a more narrowly focused part of a strategy to achieve a goal: e.g. infer neutron-star radii to xx precision, measure neutron-star masses to yy precision.

An investigation might only **make progress toward a goal** without fully achieving it.

Proposed investigations must (plan to) achieve their proposed objectives: the objectives must be **specific** enough that the proposal can make the case that they are scientifically compelling, and that the investigation can achieve them.



Requirement 7: Proposals shall state the specific science objectives and their required measurements at a level of detail sufficient to allow an assessment of the capability of the proposed mission to make those specific measurements and whether the resulting data will permit achievement of these objectives.



MIDEX (and MO) Requirements: achieving science objectives

2021 Astrophysics Explorers
Preproposal Conference

Requirement 5: Proposals shall clearly state the relationship between the science objectives, the data to be returned, and the instrument complement to be used in obtaining the required data

Requirement 8: Proposals shall describe the proposed instrumentation, including a discussion of each instrument and the rationale for its selection.

The traceability matrix (**Requirement B-17**) tabulates what must be observed, to what precision, for how many objects, etc. to achieve the science objectives of the mission.

Requirement 10: Proposals shall not include any descopes or other risk mitigation actions that result in the mission being unable to achieve the Threshold Science Mission objectives.



MIDEX (and MO) Requirements: data management and archiving

2021 Astrophysics Explorers
Preproposal Conference

Requirement 6: Proposals shall include a Data Management and Archiving Plan to calibrate, analyze, publish, and archive the data returned, and shall demonstrate, analytically or otherwise, that sufficient resources have been allocated to carry out that Plan within the proposed mission cost. The data plan shall discuss and justify any data latency period (see Appendix B, Section E.4, Reqs B-23, B-24 for additional detail).

Section 4.5.2 of the MIDEX AO states: Following a short latency period, all data will be made available to the user community... **No period of exclusive access is permitted.** The Principal Investigator proposes and justifies any data product latency period for standard data products listed in the proposal, based primarily on the time required to produce, quality check, and validate the products. Barring exceptional circumstances, data product latency may not exceed six months.



Evaluation of Scientific Merit (1)

2021 Astrophysics Explorers
Preproposal Conference

The information provided in a proposal will be used to assess the intrinsic scientific merit of the proposed investigation. Scientific Merit will be evaluated for the Baseline Science Mission and the Threshold Science Mission. There are three factors.

Factor A-1. Compelling nature and scientific priority of the proposed investigation's science goals and objectives.

- This factor includes the clarity of the goals and objectives;
- how well the goals and objectives reflect program, Agency, and National priorities;
- the potential scientific impact of the investigation on program, Agency, and National science objectives;
- and the potential for fundamental progress,
- as well as filling gaps in our knowledge relative to the current state of the art.



Scientific Merit (2)

2021 Astrophysics Explorers
Preproposal Conference

Factor A-2. Programmatic value of the proposed investigation.

- This factor includes the unique value of the investigation to make scientific progress in the context of other ongoing and planned missions;
- the relationship to the other elements of NASA's science programs;
- how well the investigation may synergistically support ongoing or planned missions by NASA and other agencies; and
- the necessity for a space mission to realize the goals and objectives.



Scientific Merit (3)

2021 Astrophysics Explorers
Preproposal Conference

Factor A-3. Scientific value of the Threshold Science Mission.

- This factor the scientific value of the Threshold Science Mission using the standards in Factor A-1 of this section, and whether that value is sufficient to justify the proposed cost of the mission.

Factors A-1 and A-2 are evaluated for the Baseline Science Mission, assuming it is implemented as proposed and achieves technical success.

Factor A-3 is similarly evaluated for the Threshold Science Mission.

NOTE: This evaluation factor is numbered A-4 in the SALMON-3 AO. The content of SALMON-3 Factor A-3 is covered in Factors B-1 and B-3.



Scientific Implementation Merit and Feasibility (1)

2021 Astrophysics Explorers
Preproposal Conference

The information provided in a proposal will be used to assess merit of the plan for completing the proposed investigation, including the scientific implementation merit, feasibility, resiliency, and probability of scientific success of the proposed investigation. There are 5 factors.

- **Factor B-1. Merit of the proposed mission architecture, instruments, and measurement techniques for addressing the goals and meeting the science objectives.**
- This factor includes how well the anticipated measurements support the goals and objectives;
- the appropriateness of the selected instruments and mission architecture for addressing the goals and objectives;
- and the appropriateness of the mission requirements for guiding development and ensuring scientific success.



Scientific Implementation Merit and Feasibility (2)

2021 Astrophysics Explorers
Preproposal Conference

Factor B-2. Probability of technical success.

- This factor includes the maturity and technical readiness of the instruments, or demonstration of path to achieve necessary maturity;
- the adequacy of the plan to develop the instruments within the proposed cost and schedule;
- the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks;
- the likelihood of success in developing any new technology that represents an untested advance in the state of the art;
- the ability of the development team - both institutions and individuals - to successfully implement those plans; and
- the likelihood of success for both the development and the operation of the instruments within the mission design.



Scientific Implementation Merit and Feasibility (3)

2021 Astrophysics Explorers
Preproposal Conference

Factor B-3. Data adequacy, analysis, and archiving

- This factor includes the degree to which the proposed mission and instruments can provide the quality and quantity of data necessary to complete the investigation and meet the proposed science objectives.
- Additionally, it includes the merit of data analysis plans, including the fidelity of physical models required to connect the measurements to the science objectives; and
- plans for archiving, to preserve data and analysis of value to the science community.

Considerations in this factor include

- planning and budget adequacy, with plans for well-documented, high-level data products and software usable to the entire science community; adequate resources for physical interpretation of data;
- reporting scientific results in the professional literature (e.g., refereed journals); and
- timely release of the data to the public domain.



Scientific Implementation Merit and Feasibility (4)

2021 Astrophysics Explorers
Preproposal Conference

Factor B-4. Science resiliency.

- This factor includes both developmental and operational resiliency.
- Developmental resiliency includes the approach to descoping the Baseline Science Mission to the Threshold Science Mission in the event that development problems force reductions in scope.
- Operational resiliency includes the ability to withstand adverse circumstances, the capability to degrade gracefully, and the potential to recover from anomalies in flight.



Scientific Implementation Merit and Feasibility (5)

2021 Astrophysics Explorers
Preproposal Conference

Factor B-5. Probability of science team success.

- This factor will be evaluated by assessing the experience, expertise, and organizational structure of the science team and the mission design in light of any proposed instruments.
- The role of each Co-Investigator will be evaluated for necessary contributions to the proposed investigation;
- Inclusion of Co-Investigators who do not have a well defined and appropriate role may be cause for downgrading of the proposal.
- **Small Complete Missions of Opportunity** are Class D payloads; accordingly, the scientific expertise of the PI will be evaluated but not his/her experience with NASA missions. Comments about the managerial experience of the PI, and whether appropriate mentoring and support tools are in place, will be made to the Selecting Official, but these comments shall not impact the “Investigation Implementation Merit” rating.



Science reviewers: conflict of interest

2021 Astrophysics Explorers
Preproposal Conference

Science reviewers are generally active scientists, and must avoid conflicts of interest through their organizational affiliations and scientific activities.

Rules for conflict of interest follow SPD-01A, as for research proposals. But in contrast to research proposal reviews, every MDEX proposal competes with every other MDEX proposal, and every MO competes with every other MO. This means

- A reviewer with a conflict of interest with one MDEX proposal has a conflict with all of them; similarly for MOs.
- Thus if one MDEX proposal includes a Co-Investigator (or other funded participant) from organization X, **no employee of organization X** can review any MDEX proposal; similarly for MOs.
- Science collaborators, and hence the organizations that employ them, contribute effort to a proposal. Before inviting other scientists from such organizations as reviewers, we must consider scientific community standards on conflict of interest. In particular, **someone who is a collaborator on a MO proposal cannot review any other MO; similarly for MDEX.**

An over-large science team may result in a weakness on Factor B-5, and reduces the reviewer pool.

If all the experts in your field are on your science team, who will review your proposal??

